A PROSPECTIVE STUDY ON SHORT TERM FUNCTIONAL OUTCOME ANALYSIS OF MANAGEMENT OF IPSILATERAL COMBINED FRACTURES OF FEMURAL NECK / INTER-TROCHANTERIC AND FRACTURE SHAFT OF FEMUR USING RECONSTRUCTION NAIL

Dissertation submitted to

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ORTHOPAEDIC SURGERY

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APRIL 2013

CERTIFICATE

This is to certify that this dissertation titled **"A PROSPECTIVE STUDY ON SHORT TERM FUNCTIONAL OUTCOME ANALYSIS OF MANAGEMENT OF IPSILATERAL COMBINED FRACTURES OF FEMURAL NECK / INTER-TROCHANTERIC AND FRACTURE SHAFT OF FEMUR USING RECONSTRUCTION NAIL"** is a bonafide record of work done by **Dr.J.STANLEY MICHAEL,** during the period of his Post graduate study from May 2010 to December 2012 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfillment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2013.

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DECLARATION

I declare that the dissertation entitled **"A PROSPECTIVE STUDY ON SHORT TERM FUNCTIONAL OUTCOME ANALYSIS OF MANAGEMENT OF IPSILATERAL COMBINED FRACTURES OF FEMURAL NECK / INTER-TROCHANTERIC AND FRACTURE SHAFT OF FEMUR USING RECONSTRUCTION NAIL"** *submitted by me for the degree of M.S is the record work carried out by me during the period of* ***May 2010 to December 2012*** *under the guidance of* ***Prof.V.SINGARAVADIVELU*** **M.S.Ortho., D.Ortho.,** *Associate Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S. ORTHOPAEDICS (BRANCH-II) examination to be held in April 2013.*

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INTRODUCTION

Ipsilateral fractures of the femoral neck occur in 2% to 6% of patients with femoral shaft fractures[1]. Ipsilateral hip and femoral shaft fractures are problematic because of their high complication rates. These bifocal femoral fractures are usually encountered in young patients. They are associated with high velocity injuries. They are usually accompanied by multisystem involvement[2].

Despite the rule of taking x-rays of the pelvis for all femoral fractures, we still see cases where femoral fractures are managed without diagnosis of femoral neck fractures. The incidence of missed injuries, notably fractures of the femoral neck is significant. They are reported to range between 20-30%[1,2]. Early recognition of this injury is required to prevent the inherent disabling complications like non union or avascular necrosis of head of femur[3].

Recent advances in the primary resuscitation have permitted many patients to survive their multisystem injury and undergo definitive care of their bony injuries. A review of literature revealed various operative techniques and plethora of hardware available to manage this difficult problem.

Different choices of fixation system are available like reconstruction nail, dynamic hip screw and dynamic condylar plate combined, dynamic hip screw or screws combined with external fixator, universal nail system or long gamma nail. Enders nail has also been used for such complicated fracture combination; but there is no consensus among the various authors regarding the best method of managing bifocal femoral fractures and controversy still exists[1,2].

This is a prospective study to analyse the short term functional outcome of the management of combined ipsilateral fractures of the femoral neck/intertrochanteric fractures and fractures of the shaft of femur using reconstruction nail.

AIM OF THE STUDY

To analyse the short term Functional Outcome of the management of combined ipsilateral fractures of the femoral neck/intertrochanteric fractures and fractures of the shaft of femur using reconstruction nail, done in our Institute of Orthopaedics and Traumatology, Madras Medical College and Rajiv Gandhi Government General Hospital between the period of June 2010 and December 2012.

REVIEW OF LITERATURE

Historically, bifocal fractures of the femur was a relatively uncommon injury. The severity of these injuries is demonstrated by the fact that early descriptions of fractures of the femoral shaft associated with ipsilateral fractures of the femoral neck are the result of autopsy findings of patients who had sustained significant trauma. These were reported by Ravaglia et al in the year 1935[4].

In a meta-analysis of 659 cases of concurrent ipsilateral fractures of the hip and femoral shaft, spread over thirty years, published by Antti Alho et al in 1996,[5] the median age of the patient was 34 (8-76) years. In a consecutive series of 1003 femoral shaft fractures over 8 years reported from Swedish hospitals, in 1965, Dencker identified 8 bifocal fractures giving a rate of 0.8%[6]. Among 1425 consecutive femoral shaft fractures in Taiwan, in 1991, Wu and Shih reported 42 ipsilateral hip fractures, giving a rate of 3%.[7] The rate of ipsilateral bifocal femoral fractures depended on the frequency of high energy injuries in the population[5].

TYPES OF HIP FRACTURE

The femoral neck fractures, were divided into subcapital,

midcervical, and basicervical based on the location. Basicervical location was the commonest, occuring in 62% of all femoral neck fracture cases. A real subcapital location, with the fracture line medial to the midcervical transverse line of the femoral neck could be identified only in three instances by Alho[5]. The trochanteric fractures were transverse, inter-trochanteric according to Dencker 1965[6],and Wolfgang 1976[8]. The trochanteric fractures were seldom communited[5,6,7,8,9]. When Alho calculated on the basis of series in which both cervical and trochanteric fractures were reported, trochanteric fractures had an average frequency of 28%of all combined ipsilateral hip and shaft fractures[4].

DELAYED DIAGNOSIS OF THE HIP FRACTURE

The percentage of delayed diagnosis of the hip fracture in bifocal femoral fractures was reported around 30%[8,9]. The delay was from one day to several months. The diagnostic protocol of the hospital and the fracture type determined the frequency of delayed and missed diagnosis. Late diagnosis was low when the protocol included the hip radiograph in every femoral fracture. In most of the missed primary diagnosis, the hip fracture was minimally displaced[9,10]. Delayed diagnosis necessitated the need for a separate

later operation and increased costs. Some non unions of the femoral neck resulted from a totally missed diagnosis of the neck fracture during the primary care[12,13].

AVASCULAR NECROSIS OF THE FEMORAL HEAD

Circulatory problems in the femoral head were rare. Swiontkowski et al, in 1984, reported 5 instances of avascular necrosis in 167 femoral neck fractures with a follow up of 2 years or more. The rate of avascular necrosis was 3%. The avascular necroses occurrence was not associated with the delay in diagnosis or the time of operation[14]. Alho reported that the incidence of osteonecrosis in ipsilateral femoral neck-shaft fractures is less than that in simple femoral neck fracture[5].

TREATMENT TECHNIQUES

Closed Treatment

Mackenzie in 1976 reported closed treatment consisting of skeletal traction through the tibial tubercle. The trochanteric fracture was conservatively treated but the neck fracture was always fixed. There were more complications with closed treatment. Since 1979, there have not been reported any conservative series[11].

Ender's nail

Intramedullary nailing with multiple flexible Ender's nail was used by Casey and Chapman in 1979[15] to treat these combined fractures. Supplementary pins were placed in the neck. Malunions and nonunions were common, because the Ender's nail failed to control the fracture.

SCREW FIXATION OF THE HIP COMBINED WITH PLATE FIXATION OF THE SHAFT

The AO/ASIF techniques were used in screw fixation of the hip, and plate fixation of the shaft by Scintowsky in 1984[18]. The treatment of the hip fracture was uncomplicated in 82 cases; there was only one avascular necrosis of the femoral head reported in 61 neck fracture cases; there was one malunion reported in 21 trochanteric fractures. The outcome therefore depended mainly on the result of the treatment of the shaft fracture. There were 5 reoperations, 3 malunions, 8 nonunions, and 5 cases of infections. Similar results were reported in unlocked Kuntscher nailing of the shaft, combined with screw fixation of the hip by Bennet[10].

INTRAMEDULLARY NAILING OF THE FEMORAL SHAFT AND COMBINED WITH SCREW FIXATION OF THE FEMORAL NECK

Bucholz and Rathjen in 2001 reported this combination of combined pinnings and nailings. It is recommended that the screws

should be inserted behind or in front of the nail, and in a more or less parallel fashion. Locked nailing yielded better results than unlocked nailing[16].

RECONSTRUCTION NAIL

The reconstruction nail by Russel and Taylor was designed with two overall goals for treating femoral fractures. The first goal was to improve the functional outcome of previously available interlocking nails by reducing complications. The second goal was to design an interlocking nail system that would be more acceptable in the management of complex femoral fractures[20].

In 1992, Bose et al reported the advantages of reconstruction nailing. The reported advantages were minimal surgical trauma, less blood loss, less operating time, single device positioning, biological fixation of the shaft fracture and better aesthetic results[21].

In the reconstruction or cephalomedullary nails, hip screws are used for the proximal locking. There exists today several modifications of the Russel and Taylor[20] design. The hip screws slide in the holes of the nail. This design gives strength against bending.

The concomitant hip and shaft fractures can be fixed with a single implant. Nevertheless it may be difficult to align rotationally the nail and proximal locking holes; this may result in displacement of the neck fragment[20].

Kao et al[22] treated 15 ipsilateral femoral neck and shaft fractures over a period of six years from 1999 to 2005 with the Russel Taylor reconstruction nail. The median operating time was 280 mins (range 125-430mins).The median blood loss was 300ml (range 100-600ml).The union rates for neck and shaft fractures were 100 and 84% respectively. The average union time was 3 months for neck fractures and 8.5 months for shaft fractures.

They concluded that reconstruction nails are alternative acceptable devices to treat combined ipsilateral femoral neck and shaft fractures[22].

Shetty et al treated 27 ipsilateral femoral neck and shaft fractures over a period of ten years from 1995 to 2005 using reconstruction nail. The functional outcome was analysed using the Friedman and Wyman score, 76% had good outcomes and 9% had poor outcomes. The authors felt that reconstruction nailing is a technically demanding procedure with a steep learning curve. They

reported lower blood loss, closed technique and biological fixation of both fractures as the advantages of using reconstruction nailing. They encountered technical problems in placing the screws into the neck. They were able to achieve this by significant internal rotation of the femur. Biomechanically reconstruction nails are load sharing devices and early mobilization was possible.[23]

In 2006, Garg et al reported a study of treating 25 patients of ipsilateral hip fracture and shaft of femur using reconstruction nail from 1996-2003 with a minimum follow up of one year. Intraoperative complications were critically analyzed. They reported difficulty in achieving reduction in 13 patients, improper placement of cervical screws in 11patients and postoperative distraction present at fracture site in 7 patients.7 patients had malunion at hip and three had malunion at femoral shaft. Nonunion at the femoral shaft was seen in three patients requiring second surgery. They concluded that reconstruction nail was a good implant for undisplaced or minimally displaced fractures at hip. But for fractures with marked displacement and communition at hip fracture site, the reconstruction nail results were good only in experienced hands.[24]

In 2011, Tsarous et al reported treating 11 patients of combined ipsilateral femoral neck and shaft fractures with reconstruction nail over a period of 4 years from 2004 to 2008. The mean union time was 4 months for the neck fracture and 8 months for the shaft fracture. There was no avascular necrosis of the femoral head. They reported two cases of shaft non-union[25].

In February 2012, Khan et al reported treating 38 patients of combined ipsilateral fractures of the neck and shaft of femur using reconstruction nail from 2005to 2011. Functional outcome was analyzed using the Freidman and Wyman system[36]. 33 patients (87%) had good outcome and 5 patients (13%) had fair outcomes. They concluded that reconstruction nail is an effective surgical implant in fixing both fractures simultaneously without compromising fracture healing[26].

Reconstruction nails are ideal devices for concomitantly treating ipsilateral hip and femoral shaft fractures in a single incision wound. A closed technique can minimize bleeding; wound complications are less. Familiarity in surgical technique can significantly improve operating time and technical faults[16,17].

Reconstruction nails allow for the treatment of ipsilateral hip

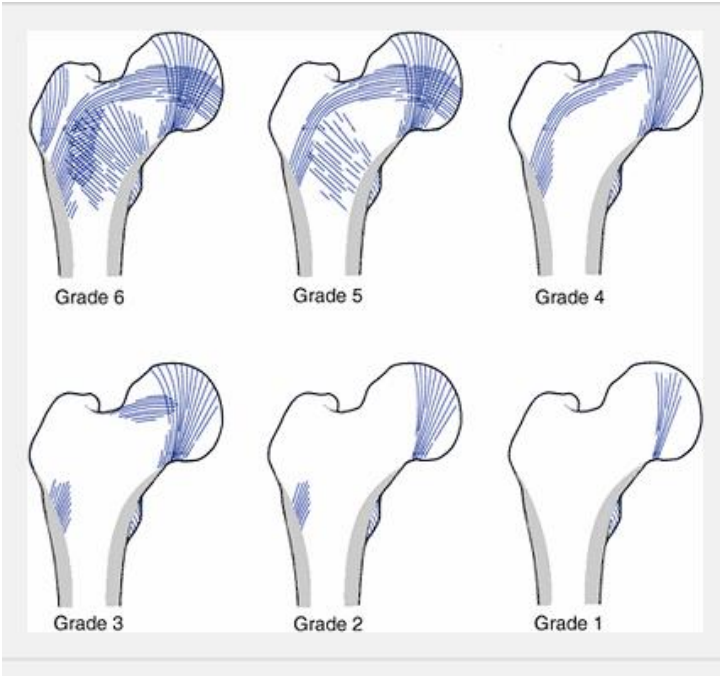
and femoral shaft fractures, by combining two sliding screws for stabilization of the femoral neck with distal locking capabilities. The reconstruction nail uses standard locking screws distally, which are fully threaded to ensure optimum bone purchase and also to prevent backing out[20].

However several disadvantages in reconstruction nailing have been reported by Tsai et al in 2009.The procedure is technically demanding. Nail insertion may cause further displacement of the femoral neck fracture, which then becomes difficult to reduce. There were reported difficulties in obtaining rotational alignment of the fracture. There was also reported difficulty in achieving correct position of the proximal interlocking screw[27].

APPLIED ANATOMY

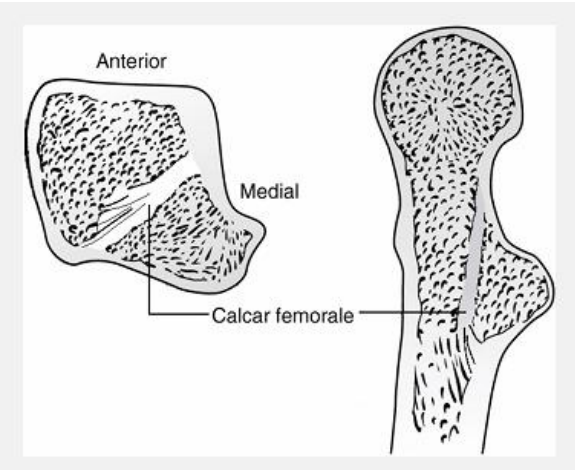
SKELETAL ANATOMY

The femoral head is not a perfect sphere. The hip joint is congruous only in the weight-bearing position. In 1838, Ward described the internal trabecular system of the femoral head. The orientation is along lines of stress; thicker lines come from the calcar; they rise superiorly into weight-bearing dome of the femoral head. Forces acting in this arcade are largely compressive. The presence of osteoporosis is important, because the osteoporotic bone has poor ability to hold an internal fixation device. Singh's index for the diagnosis and grading of osteoporosis is based on trabecular pattern on x-rays of the upper end of the femur.



Singhs Index

The calcar femorale is thicker medially, gradually thinning out as it passes laterally.



Left: The calcar femorale is a vertical plate of bone; originates in the posteromedial portion of femoral shaft under the lesser trochanter- radiates laterally towards posterior aspect of the greater trochanter. ***Right***: The calar femorale fuses with posterior aspect of femoral neck superiorly - extending distally anterior to the lesser trochanter; fuses with the posteromedial aspect of femoral diaphysis.

VASCULAR ANATOMY

Crock[28] described the arterial supply of the proximal end of the femur in three groups:

(a) an extracapsular arterial ring - at the base of the femoral neck;

(b) ascending cervical branches of the extracapsular arterial ring-located on the surface of the femoral neck; and

(c) the arteries of the round ligament.

A large branch of the medial femoral circumflex artery forms the extracapsular arterial ring posteriorly; branches of the lateral femoral circumflex artery form the ring anteriorly. Minor contributions to this ring come from the superior and inferior gluteal arteries.

From the extracapsular arterial ring arise the ascending cervical branches, known as retinacular arteries; they were described initially by Weitbrecht.[29] The proximity of the retinacular arteries to bone renders them at risk for injury in any femoral neck fracture.

Because of excellent vascular supply to the metaphysis, there are no avascular changes in the femoral neck as compared to the femoral head[29].

The ascending cervical arteries can be divided into four groups, anterior, medial, posterior, and lateral based on their relationship to the femoral neck. Most of the blood supply to the femoral head and neck, is from the lateral group.

On the surface of the neck of the femur, at the margin of the articular cartilage, these vessels form a second ring, described by Chung[29] as the subsynovial intra-articular arterial ring. Epiphyseal arterial branches arise at the subsynovial intra-articular ring, and enter the femoral head. Claffey[30] has demonstrated that aseptic necrosis occurs in all femoral neck fractures that communicate with the point of entry of the lateral epiphyseal vessels.

Howe et al[31] found that the vessels of the ligamentum teres do

supply the femoral head, but after a displaced femoral neck fracture, they are inadequate in assuming the role of major vascularity of the femoral head. Trueta and Harrison[32] reported that the femoral epiphyseal blood supply in adults arises largely from the lateral epiphyseal arteries; Sevitt and Thompson also demonstrated that most femoral head circulation is from the superior retinacular and lateral epiphyseal vessels.

CLINICAL SIGNIFICANCE OF VASCULAR ANATOMY

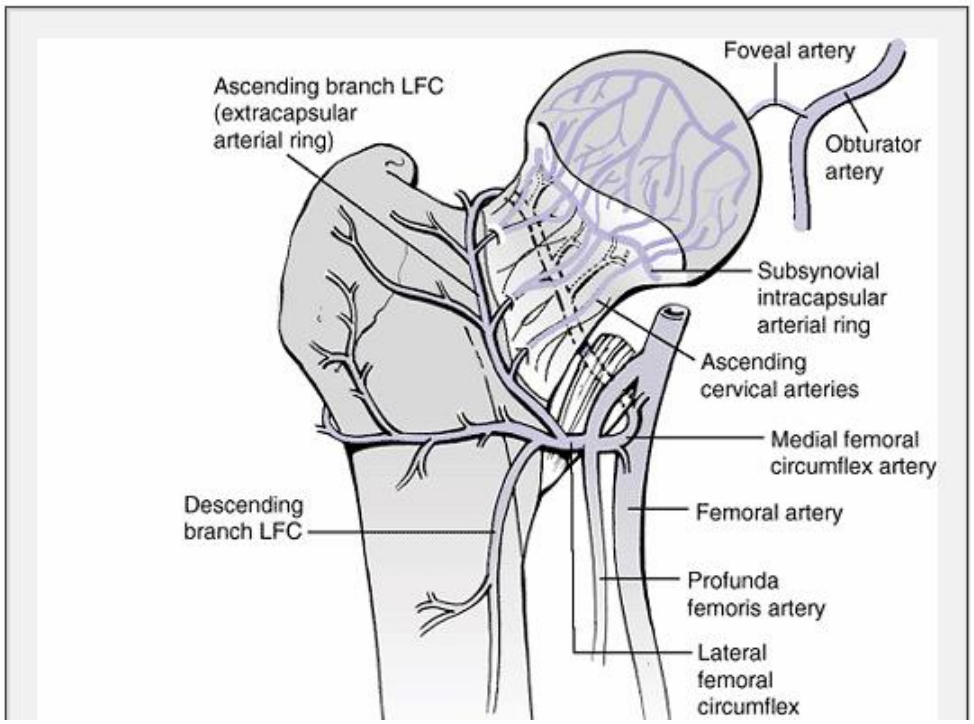
Femoral head circulation arises, therefore, from three sources:

(1) intraosseous cervical vessels which cross the marrow spaces from below

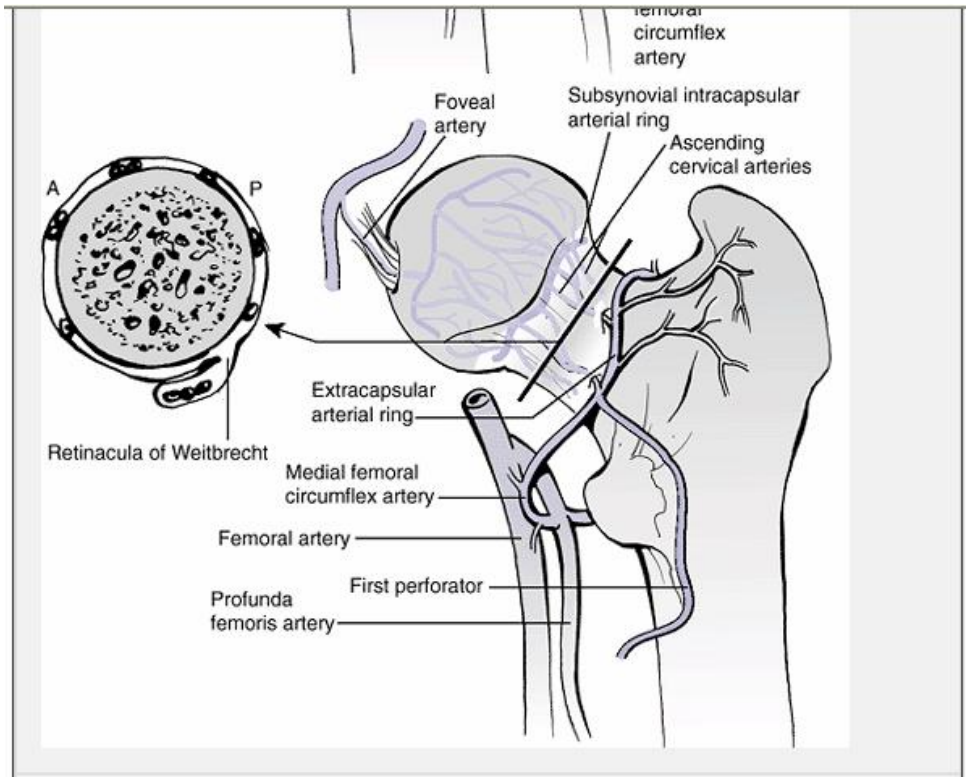
(2) the artery of the ligamentum teres (medial epiphyseal vessels);

(3) the retinacular vessels, which are branches of the extracapsular arterial ring. They run along the femoral neck beneath the synovium.

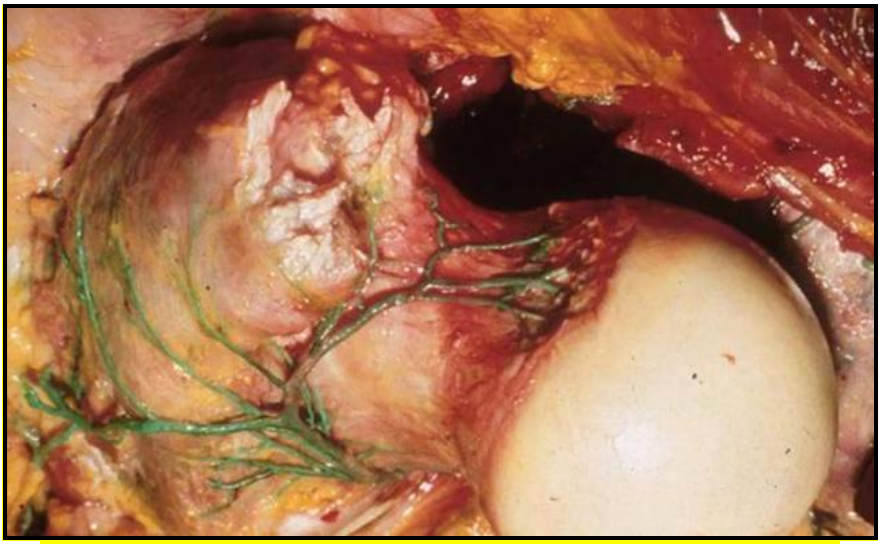
The intraosseous cervical vessels are disrupted, when a femoral neck fracture occurs. Nutrition of the femoral head is then dependent on the remaining retinacular vessels. These facts necessiate prompt reduction and stable fracture fixation in femoral neck fractures. The metaphyseal vessels will thereby promptly reestablish and restore circulation.



Vascular anatomy of the femoral head and neck, Anterior aspect



Vascular anatomy of the femoral head and neck, Posterior aspect



Ascending branch of medial femoral circumflex

SURGICAL ANATOMY OF THE FEMORAL SHAFT

The femur is the longest bone in the human body. It is tubular. The femur has an anterior - radius of curvature of approximately 120 cm. The femoral shaft is cylindrical anteriorly, medially, and laterally. The thickened posterior cortex of the femoral shaft coalesces into the linea aspera in the centre. The femur is almost completely encased in muscles. Most of the muscles have attachments to the bone itself. Knowledge of these muscle attachments is important and helps to perform atraumatic surgical dissections. It also helps to understand the commonly observed deformity patterns.

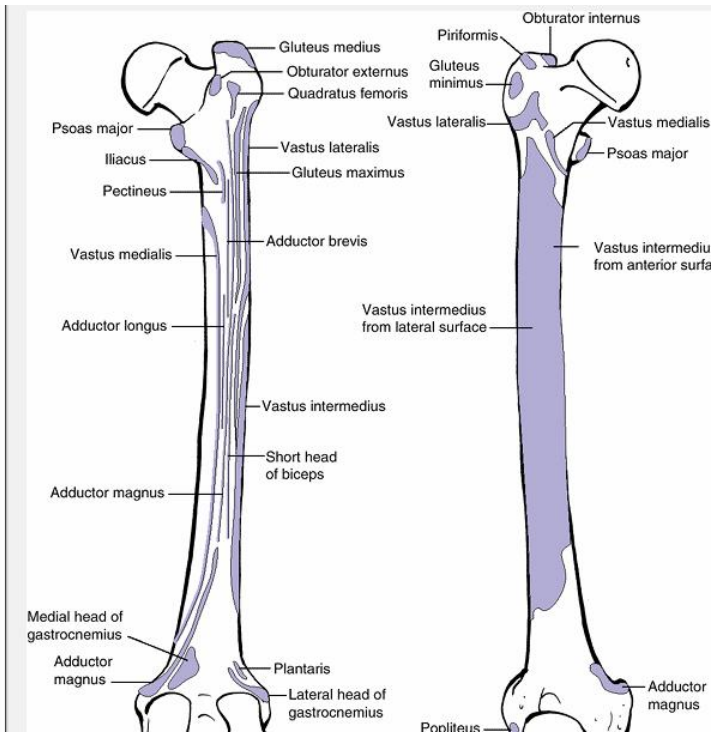
The proximal muscular attachments are:

- hip abductor and short external rotator muscle insertions at

the greater trochanter,

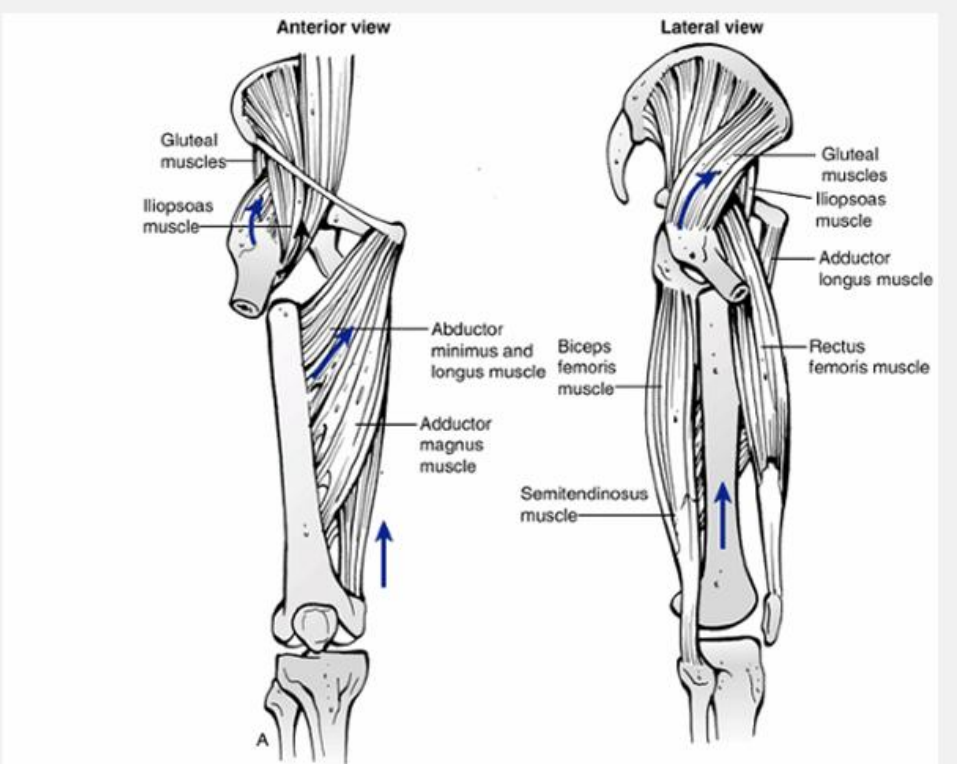
- gluteus maximus osseus insertion at the posterolateral proximal femur,
- iliacus and psoas insertions on the lesser trochanter.

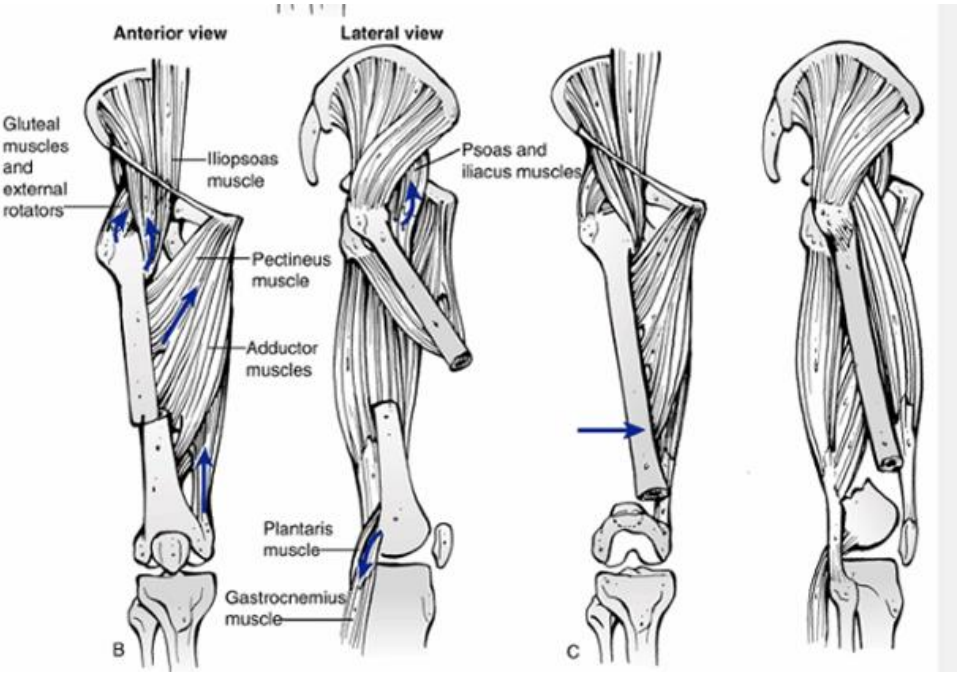
The adductors insert on the femur along its length, on the posterior and medial aspects. The vastus lateralis originates proximally, just distal to the gluteus medius insertion. The vastus intermedius originates from the anterior and lateral femur from along the majority of the diaphysis. The vastus medialis originates from the medial and posteromedial portions of the femur. The gastrocnemius originates distally from the posterior aspect of the femoral condyles.



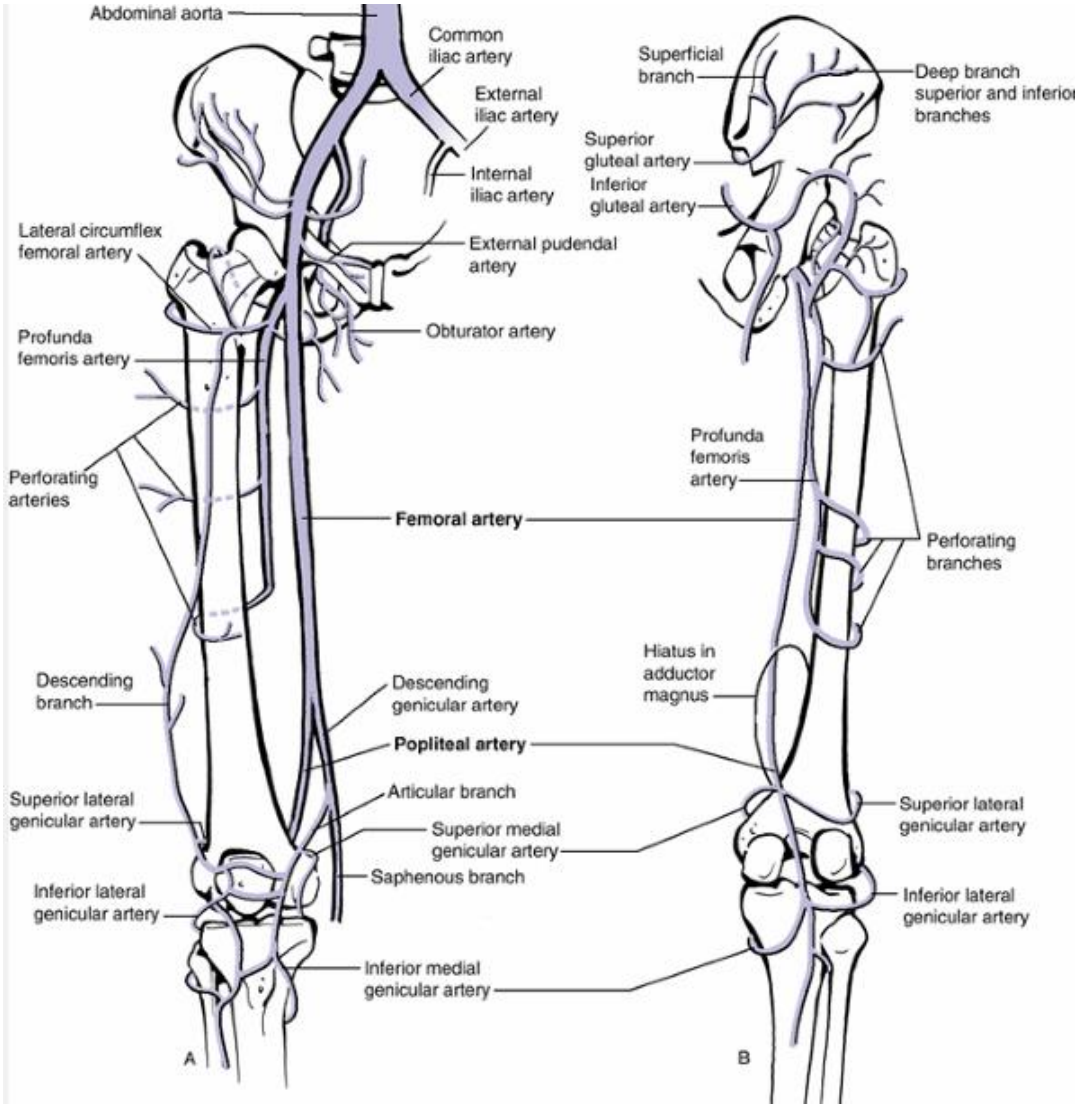
Primary muscular attachments on the anterior and posterior aspects of the femur

The observed deformities and displacements are determined by the muscular attachments and fracture location.





VASCULAR ANATOMY OF THE THIGH



MECHANISM OF INJURY

Ipsilateral fractures of the femoral neck/intertrochanteric fractures associated with femoral shaft fractures, occur in high velocity trauma, such as road traffic accidents and falls from height, and consequently patients suffer multiple injuries[10,11,12,13,14].

The mechanism of injury is thought to be compression of the femur with the limb in abduction[13]. Patients sustain high energy impaction with the hip in abduction. The majority of energy is dissipated in the shaft, which induces a comminuted fracture in the femoral shaft. When the sustained energy is even higher, femoral neck fractures. However, in these situations the femoral neck fracture is less severe. In the reported literature, most femoral neck fractures were non-displaced or minimally displaced; as a result they can be easily missed.

The low incidence of neck nonunion and osteonecrosis of the femoral head in this bifocal femoral fracture is because most of the energy has been dissipated in the shaft; satisfactory outcomes are reported for neck fractures. The femoral shaft absorbs most of the energy; this results in more severe injury than in the femoral neck; this leads to a longer union time in the severely injured shaft group.

The union time of the shaft mainly determines the period of disability. More severe shaft injuries have a longer union time. The outcome of this combined fracture depends mainly on the result of treatment of the femoral shaft fracture. A more severe shaft injury leads to a worse result. Careful management of shaft fractures and post operative protected weight bearing are therefore very crucial in management of these fractures.

Half of neck fractures are undisplaced in these bifocal femoral fractures[11,12]. Fractures of the femoral shaft are usually at the junction of the upper and middle thirds of the shaft; Ipsilateral knee injuries are common; cause significant morbidity. Their incidence ranges between 20 and 40%[14].

The magnitude of displacement as well as the comminution depends on the magnitude of the force applied as well as the strength of the bone it is applied to. A relatively low-energy injury may produce a severely comminuted fracture in an osteoporotic patient.

ASSOCIATED INJURIES

The associated injuries reported in these high velocity fractures were head injuries, chest injuries, abdominal injuries, knee injuries, upper and lower injuries in ipsilteral and contralateral side[5,6,7,9,11]

FRACTURE CLASSIFICATION

The classifications of femoral neck fractures are based on

(a) anatomic location of the fracture

(b) direction of the fracture angle and

(c) displacement of the fracture fragments.

ANATOMIC LOCATION

Intracapsular

a) subcapital

b) transcervical

Extracapsular

Base of the neck fracture (basicervical)

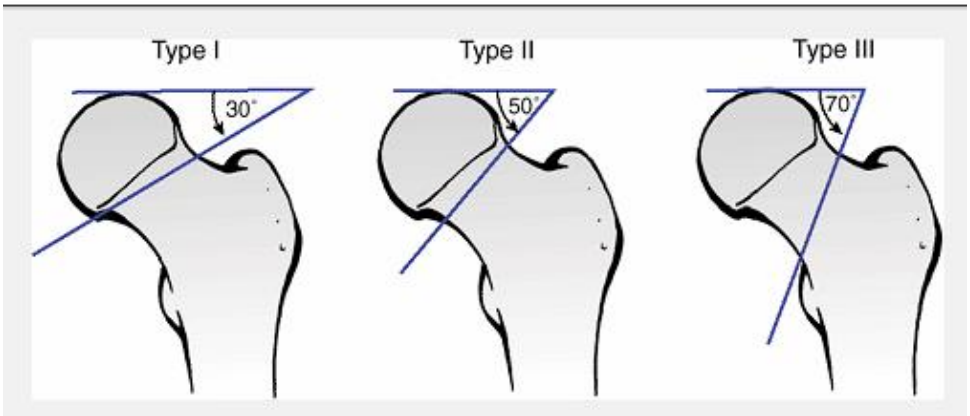
FRACTURE ANGLE (PAUWELS CLASSIFICATION)

Type I - fracture 30 degrees from the horizontal;

Type II- 50 degrees from the horizontal;

Type III- 70 degrees from the horizontal

Type I fractures are much more horizontal than Pauwell type III fractures-which are almost vertical. Pauwell attributed that nonunion in type III fractures could be due to the increased shearing force of this vertical fracture.



The Pauwels classification of femoral neck fractures; It is based on the angle the fracture forms with the horizontal plane. As fracture progresses from type I to type III, there is an increase in the obliquity of the fracture line. The shear forces at the fracture site also increase.

FRACTURE DISPLACEMENT (GARDEN CLASSIFICATION)

Based on the degree of displacement of the fracture which is noted on prereduction anteroposterior (AP) x-rays.

The Garden I fracture- incomplete or impacted fracture. The trabeculae of the inferior neck are still intact.

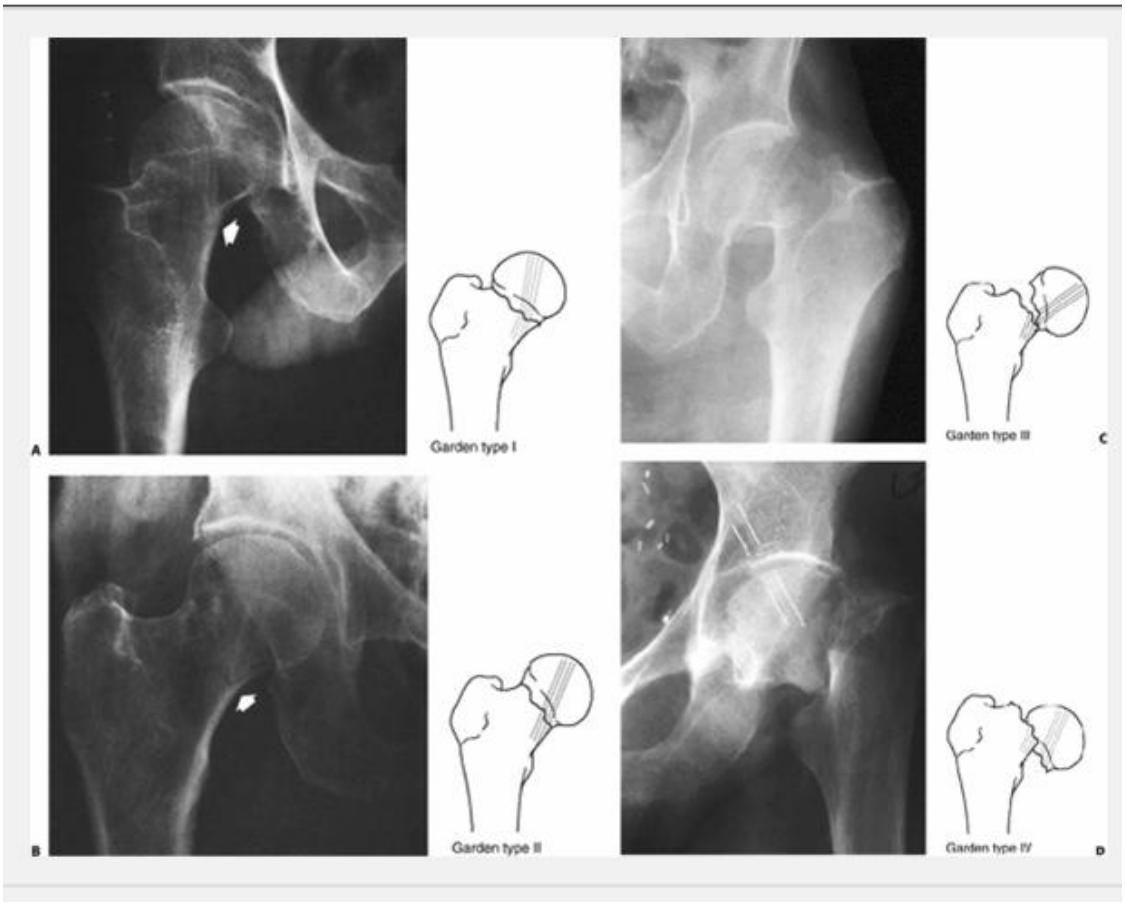
Garden II fracture- complete fracture without displacement. The weight-bearing trabeculae are interrupted by a fracture line which runs across the entire neck of the femur.

Garden III fracture-complete fracture with partial displacement. There is shortening and external rotation of the distal fragment. The retinaculum of Weitbrecht remains attached to, and thus maintains continuity between, the proximal and distal

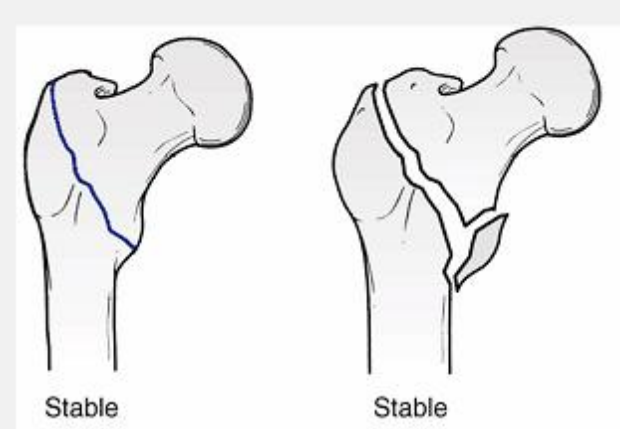
fragments. The femoral head trabecular pattern does not line up with that of the acetabulum, this demonstrates the incomplete displacement between the femoral fracture fragments.

Garden IV fracture-complete fracture with total displacement of the fracture fragments. All continuity between the proximal and distal fragments is disrupted. The femoral head assumes its normal relationship in the acetabulum. Trabecular pattern of the femoral head lines up with the acetabular trabecular pattern.

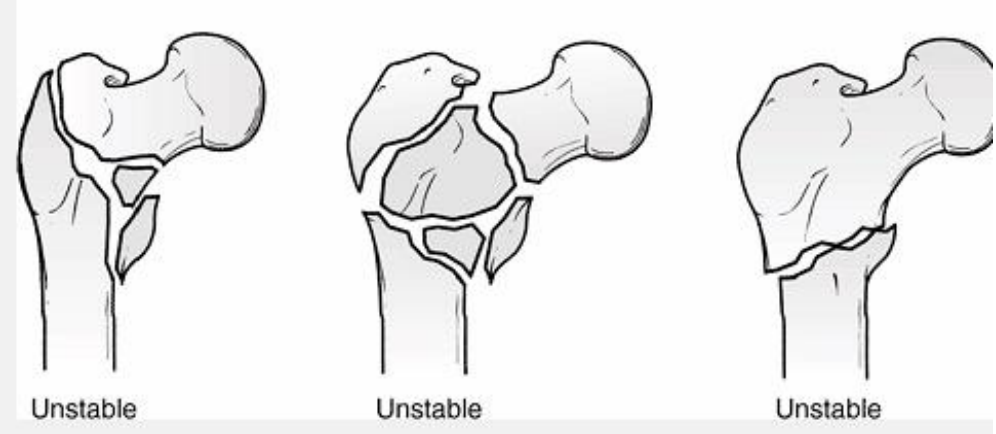
GARDEN CLASSIFICATION



EVANS CLASSIFICATION OF INTERTROCHANTERIC FRACTURES



Stable fracture patterns:
the posteromedial cortex remains intact or has minimal comminution. It is possible to obtain a stable reduction.

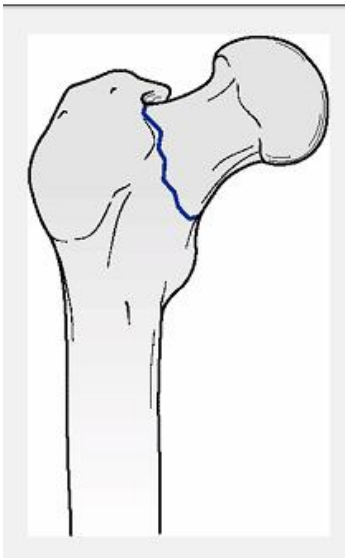


Unstable fracture patterns:
are characterized by greater comminution of the posteromedial cortex.

The reverse obliquity pattern is inherently unstable. This is because of the femoral shaft tendency for medial displacement.

Stable intertrochanteric fracture: Intact posteromedial cortex (A).

Unstable intertrochanteric fracture: disruption of the posteromedial cortex (B).



Basicervical Neck Fractures:
just proximal to or along the intertrochanteric line

CLASSIFICATION OF FEMORAL SHAFT FRACTURES

- anatomic location,
- fracture morphology,
- degree of comminution,

The femoral shaft fracture may be described based on anatomic location, as

- proximal third,
- middle third,
- Distal third in location, or at the junctions between these

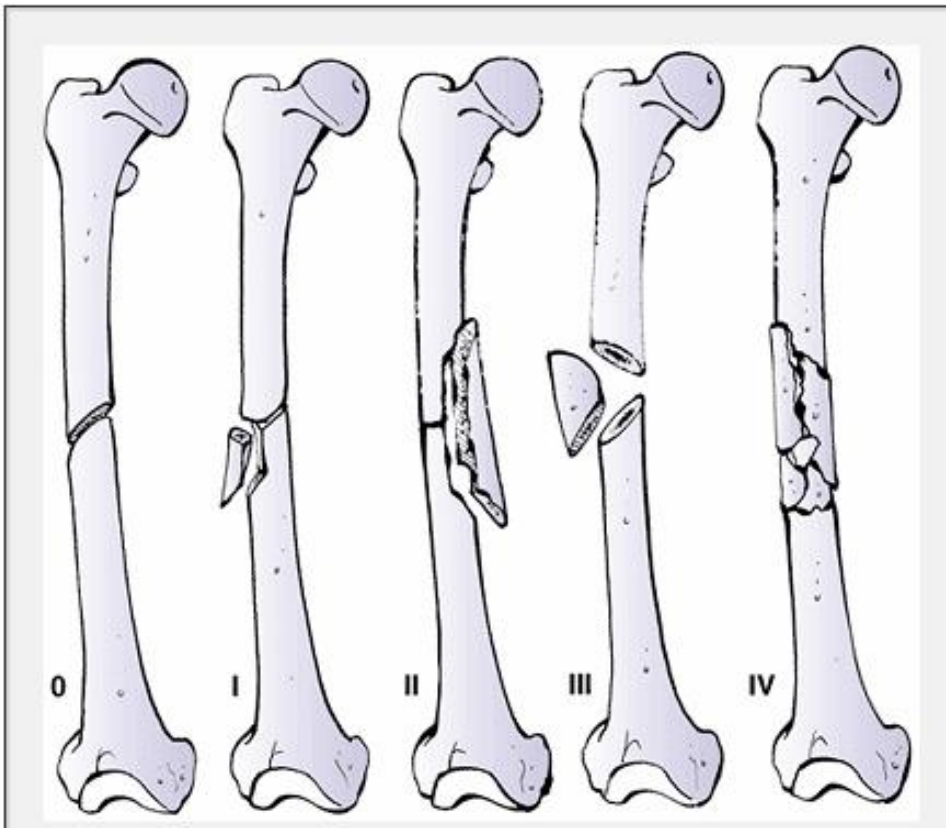
Fractures of the femoral shaft may be described on the basis of the location relative to the isthmus

- Infraisthmal fractures: the nail will not assist with reduction of the fracture.
- Isthmal: easy reduction with appropriately sized medullary implant.

Fractures described on the basis of the fracture geometry :

- transverse,
- oblique,
- spiral,
- or comminuted.

WINQUIST-HANSEN CLASSIFICATION FOR DIAPHYSEAL FEMORAL COMMINUTION



Winquist classification of ipsilateral femoral neck shaft fractures[35]

Fractures communition is graded from Grade 0 to Grade IV - based on percentage of intact shaft at the site off fracture

- *Grade 0 fractures : have no associated communition.*
- *Grade I fractures : have a small chip or fragment of communition.*
- *Grade II fractures : have a small butterfly fragment. But at least 50% of the cortex is intact.*
- *Grade III fractures : have a larger butterfly fragment. There is minimal cortical abutment predicted.*
- *Grade IV fractures : have no predicted cortical contact between the fracture fragments. They are referred to as segmentally comminuted.*

CLASSIFICATION OF COMBINED IPSILATERAL FEMORAL NECK-SHAFT FRACTURE[35]

	Group 1	Group 2	Group 3
Classification	Non-displaced femoral neck fracture	Missed femoral neck fracture	Displaced femoral neck fracture
Description	Combination of femoral shaft fracture and non-displaced femoral neck fracture	Diagnosis of femoral neck fracture is missed initially; sequential femoral neck fracture findings were discovered after shaft nailing	Combination of femoral shaft and displaced femoral neck fracture

CLINICO RADIOLOGICAL ASSESSMENT

On receiving the patient in emergency department, general condition is assessed rapidly. Primary survey of airway, breathing, and hemodynamic status is done and resuscitation is done. Secondary survey is done in detail to assess the skeletal examination, examination of abdomen and pelvis and central nervous system.

History is important as the mode of injury gives the magnitude of force and its direction on which the pattern, displacement and comminution of fracture depends.

Physical examination includes thorough inspection for external injuries, wounds, contusions and bruises. Attitude of the injured limb and its distal neurovascular status must be seen.

RADIOLOGICAL INVESTIGATIONS:

After clinical assessment, patient is shifted for radiological assessment if the patient's condition is stable.

X-ray and CT Scan form the standard protocol.

- X-ray pelvis with both hips-Anteroposterior.
- X-ray of ipsilateral hip in 15 degrees of internal rotation.
- X-ray full length femur –antero-posterior and lateral
- X-ray knee joint-antero-posterior and lateral

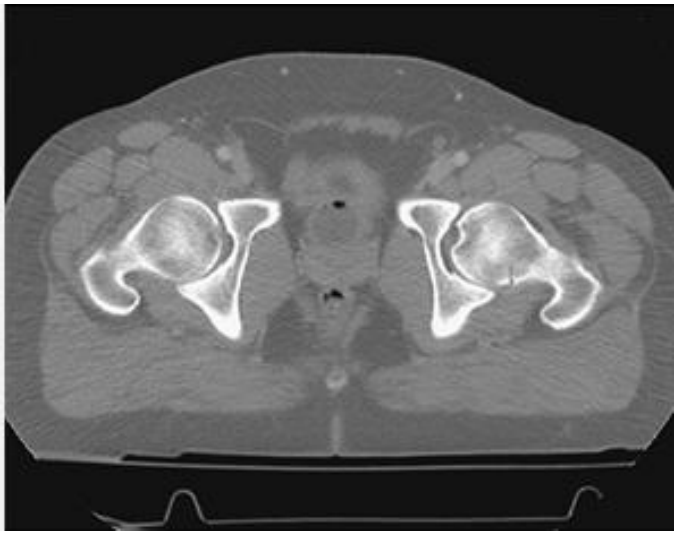
- CT scan

In patients with femoral shaft fractures, there is high incidence of missed femoral neck fractures. Therefore it is recommended to review all available imaging modalities, at multiple time points in the patient's evaluation and treatment.

1) Dedicated hip x-rays should be obtained as part of the initial radiologic evaluation in any patient with a femoral neck fracture.

2) Second, if pelvic oblique radiographs are taken suspecting ipsilateral acetabular fracture, these should be scrutinized for femoral neck fractures.

3) Third, if CT scan is done for abdominal or pelvic trauma, this should be reviewed. Occult fractures are frequently demonstrated on the relevant axial images.



4) Fourth, intraoperative fluoroscopic images before starting nailing.

5) Fifth, hip fluoroscopic images and/or x-rays should be taken after femoral shaft stabilization. The hip should be in 10 to 15 degrees of internal rotation.

6) Finally, before leaving the operating room, dedicated postoperative hip x-rays should be taken to confirm the femoral neck integrity.

Tornetta[33] et al used a best-practice protocol consisting of:

- dedicated internal rotation plain x-ray.
- a 2-mm CT scan through the femoral neck.
- a fluoroscopic lateral of the femoral neck before fixation.
- and postoperative orthogonal hip x-rays in the operative room.

In the year 2007, by using this protocol Tornetta et al[33] showed improvement in the rate of diagnosing missed femoral neck fractures, in patients who had sustained femoral shaft fractures.

It should be borne in mind to look for:

- Associated pelvic ring injuries
- Ipsilateral knee injuries
- Congruency of femoral head in acetabulum
- Ipsilateral and contralateral limb injuries.

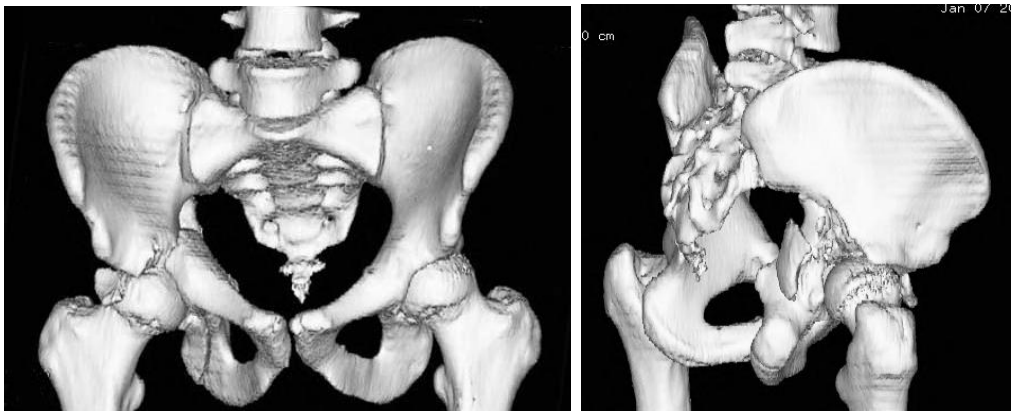
CT SCAN

CT scan helps in identification of fracture lines not visualized by radiographs and orientation of fracture line and rotation of

fracture fragments, and degree of fracture comminution.

3-D CT SCAN

It is converted from 2 dimensional CT scan data. Image quality determined by software. Provides a good overall picture of the fracture configuration.



3D reconstruction view of pelvis

INTRA OPERATIVE DIFFICULTIES &POSTOPERATIVE COMPLICATIONS [20,21,27]

The intraoperative difficulties in reconstruction nailing are:

1) Incorrect entry point.

2) Iatrogenic communition of fracture site during nail insertion.

3) Shattering of the proximal femur during nail insertion.

   Bursting of the femur could occur because of mismatch in curvature of the nail and femur, or because of high bending stiffness of the nail, or because of incorrect entry point.

4) Displacement of the undisplaced femoral neck fracture

5) Distraction at the femoral shaft fracture site.

6) Failure in achieving closed reduction, necessiating open reduction.

7) Improper placement of proximal screws in the femoral neck.

Post Operative Complications:

1) Delayed union & Non union: Femoral neck fractures should unite by 6 months. A delayed union (3 months) or nonunion (6 months) should be contemplated, if there is no evidence of healing, or alternatively if the patient continues to have pain at 3 to

6 months after surgery.

2) Malunion: Angular deformity of the femur is defined as greater than 5 degrees of angulation in either

- the coronal plane (varus-valgus)
- or sagittal (flexion-extension) plane.

A properly aligned entry point will minimize angular deformities.

Rotational malalignment is defined as more than 15 degrees of rotational malalignment and is common in unstable fractures with Winquist type 3 and 4 comminution.

3) Shortening of the femur and limb length discrepancy

4) Infection and infected non union

5) Implant failure

6) Iatrogenic nerve injury: Sciatic and peroneal nerve injuries can occur because of stretching of the nerve. Pudendal nerve palsy is associated with use of fracture table.

7) Muscle weakness can occur because of injury to hip abductors and external rotator muscles.

8) Avascular necrosis and degenerative

joint disease are rare long term complications.

9) Heterotopic ossification

10) Refracture of the femur after removal of the reconstruction nail has been reported.

11) Pain in the outer aspect of the proximal part of thigh necessitating reconstruction nail removal.

12) Knee stiffnes and Knee pain.

The advantages of the reconstruction nail approach in treating ipsilateral fractures of the femoral neck and femoral shaft are numerous-

1) lower blood loss,
2) a closed technique,
3) less soft tissue trauma,
4) biological fixation for both fractures.

METHODS AND MATERIALS

This is a prospective study of 20 patients done to assess the functional outcome of management of ipsilateral fractures of femoral neck/ intertrochanteric fractures associated with femoral shaft fractures, treated by Reconstruction nail from June 2010-Decemberer 2012 at the Institute of Orthopaedics and Traumatology, Madras medical college and Rajiv Gandhi Government general hospital, Chennai.

Patients with combined ipsilateral traumatic femoral neck/ intert-trochanteric and shaft fractures were included. Single fractures, pathological fractures, open fractures, co-morbid patients were excluded. Patients were admitted through accident and emergency department after due counselling regarding the procedure, its implications, ethical issues and consent for surgery.

Inclusion Criteria:

The inclusion criteria of the patients were,

- Patients aged above 15 years.
- patients with combined ipsilateral fractures of the femoral neck and shaft.

- Patients with combined ipsilateral fractures of the femoral shaft and intertrochanteric fractures of femur.

- Patients who consented for surgery.

Exclusion Criteria:

The exclusion criteria were,

- Patients aged less than 15 years.

- Isolated shaft fractures.

- Isolated femoral neck fractures.

- Isolated intertrochanteric fractures.

- Pathological fractures.

- Open fractures

- Patients with co-morbidities.

TREATMENT PROTOCOL

GENERAL ASSESSMENT AND RESUSCITATION

In our study after general resuscitation of the patients, a detailed clinical examination and radiological assessment was done. Priority was given for treating associated head, chest,and abdominal injuries. Other associated open injuries were debrided and stabilized. Knee spanning External fixator was applied in one case with associated open fracture of both bones ipsilateral leg.

Vascular and nerve injuries of the affected lower limb were assessed. Radiological assessment was done by taking X ray views of:

. pelvis with both hips-anteroposterior,
. affected hip with femur –traction internal rotation view,
. femur full length-anteroposterior and lateral
. ipsilateral knee joint-anteroposterior and lateral.

In case of suspected femoral neck or intertrochanteric fractures, CT scan was taken to detect neck fractures missed on X-ray. Patients were put on upper tibial pin traction till the time of surgery.

TIME OF SURGERY

There was a mean time delay of 18 days (range 7 days to 49

days) from the time of injury.

AGE INCIDENCE AND DISTRIBUTION

The Mean age of the patients was 28 years ranging from 18 to 45 years.

Age	No of Patients	Percentage
< 20 Years	02	10 %
21 to 30 Years	10	50%
31 to 40 Years	07	35%
41 to 50 Years	01	5%

Sex Incidence

All the patients were Males

Mode of Injury

Majority of the patients suffered Fall from Height, followed by Road Traffic Accidents.

Mode of injury	No. of Patients	Percentage
RTA	6	30%
Fall from Height	14	70%

FRACTURE PATTERNS:

There were19 patients with femoral neck fracture and one patient with intertrochanteric fracture.

Undisplaced fractures:

There were 2 undisplaced fractures and both of them were basicervical in location.

Displaced Fractures:

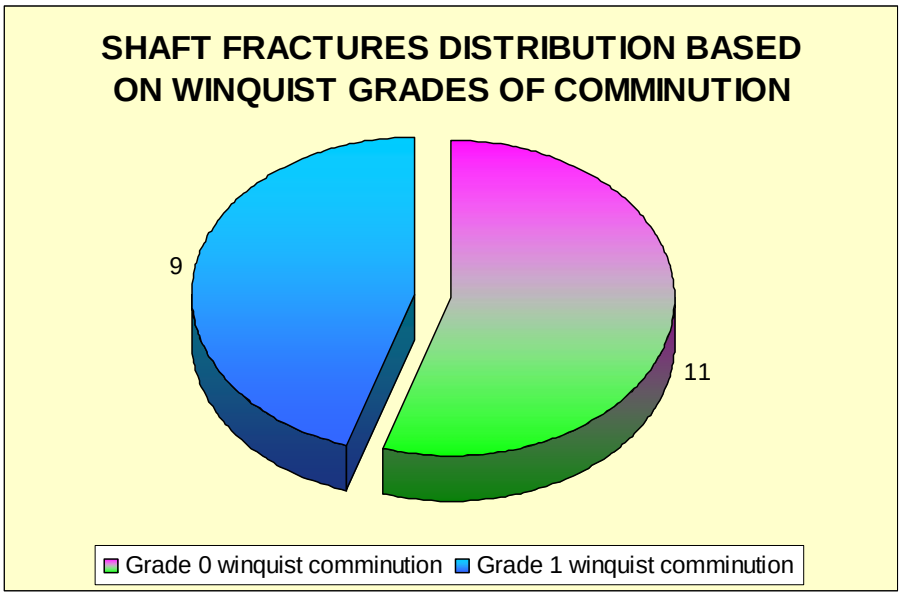
There were 18 displaced fractures: 3 of them were basicervical and 14 were transcervical and one displaced fracture was intertrochanteric.

Proximal Fracture Pattern:

Fracture type	*No. of Patients*	*Percentage*
Basicervical, Undisplaced	2	10%
Basicervical, Displaced	3	15%
Transcervical, Displaced	14	70%
Inter-Trochanteric, Displaced	1	10%

Femoral Shaft fracture:

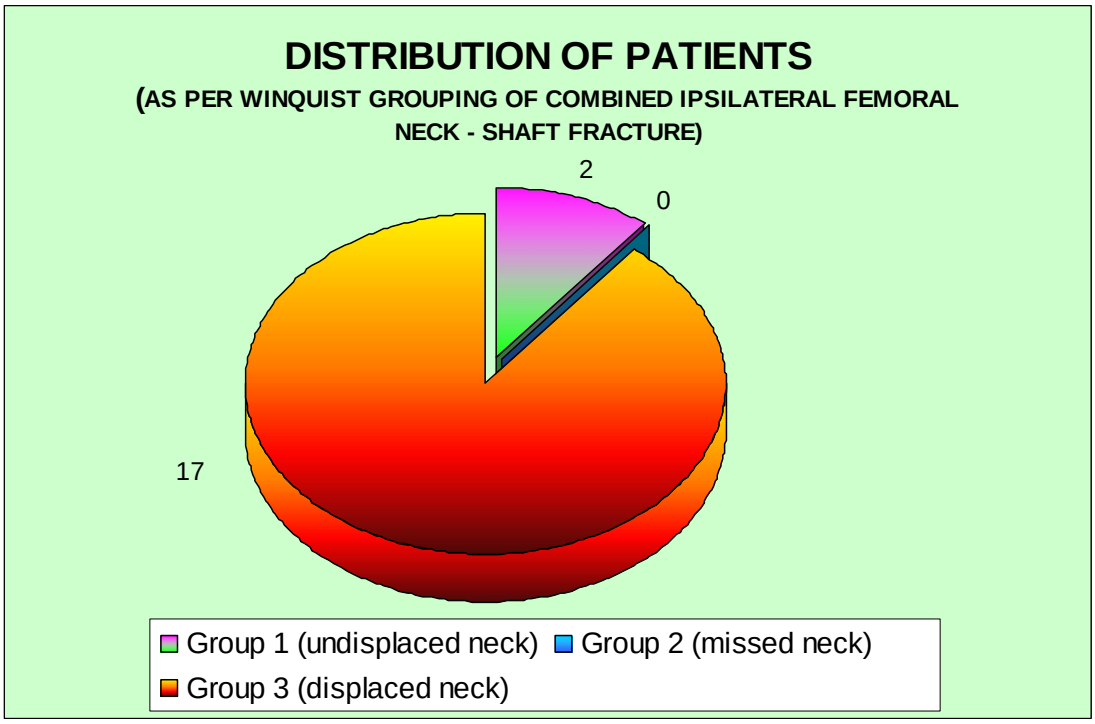
All shaft fractures were closed. Shaft fractures consisted of eleven Winquist grade 0 and nine Winquist grade 1 levels of comminution.



The shaft fractures were located in the middle third in 17 and distal third in 2 patients. One patient had a segmental fracture with a previously applied broad dynamic compression plate in-situ.

Winquist grouping of Ipsilateral femoral neck - shaft fracture:

Of the 19 ipsilateral femoral neck shaft fractures, 2 belonged to Winquist Group 1, none in Group 2 (missed neck) and 17 in group 3.



ASSOCIATED INJURIES

In our study 8 patients had associated injuries. 1 patient had head injury and patella fracture.1 patient had chest injury with rib fractures and haemothorax;1 patient had a crush injury of the contralateral limb which required below knee amputation and open fracture both bones of the ipsilateral leg;2 patients had fractures of the superior and inferior pubic ramii.

Associated injuries	No. of Patients
Fracture of clavicle	1
Fracture of Distal radius	2
Fracture of superior pubic rami	2

Fracture of Inferior pubic rami	2
Fracture both bone leg	2
Fracture Metacarpal	1
Fracture Ribs, hemothorax	1
Fracture patella	1
Head injury	1
Crush injury C/L leg necessitating amputation	1

SURGICAL TECHNIQUES:

1) Proper preoperative planning

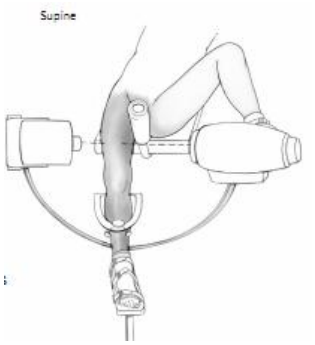
Appropriate nail diameter and length were planned by measuring at the isthmus.

2) Patient positioning and radiographic control

Patients were put on Supine position on a fracture table. Excellent AP and lateral images of the femoral head and neck were taken before the procedure

Access to the greater trochanter was improved by

- bending the torso away from the affected extremity
- adducting the affected limb

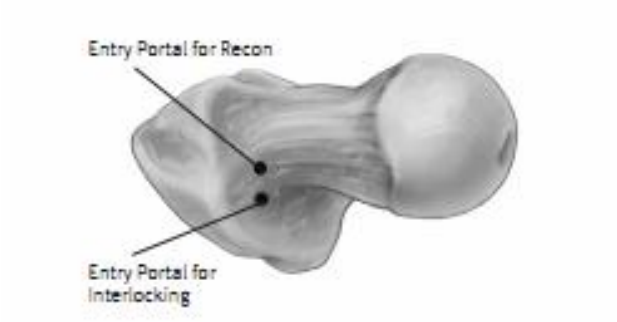


3) Reduction of the fractures was attempted before beginning the surgical procedure

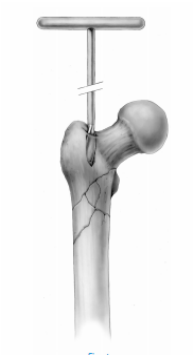
4) Incision and exposure

Skin incision was started 1cms proximal to the greater trochanter and extended proximally for 5cms in the line of the gluteus maximus. After dissection, the muscles were retracted to visualize the pyriform fossa.

5) Correct entry portal[37] was determined using C arm;5mm anterior to the standard interlocking-this was done to facilitate screw placement in the centre of the neck.



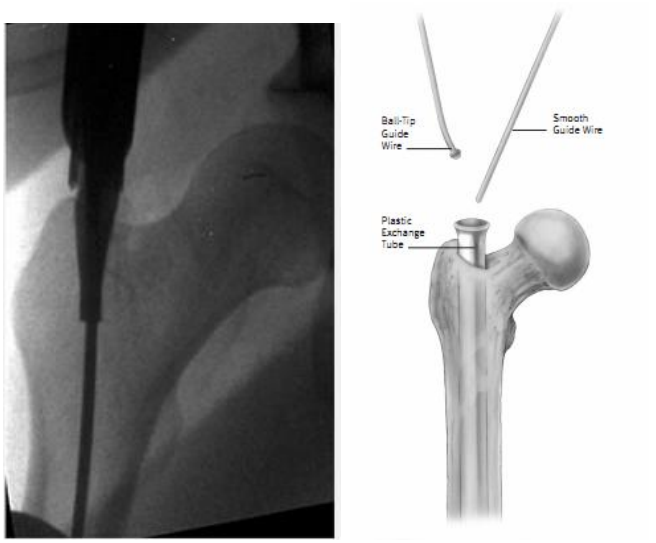
Checked the position of entry hole with awl: on AP view, the awl should lie at the base of the femoral neck adjacent to the greater trochanter.



On lateral view, the awl was oriented just posterior to the centre of the femoral neck

6) A guide wire was inserted through the piriformis fossa into the canal of the proximal fragment and reaming was performed. A 3mm ball tip guide wire-bent at 10 degrees, 5cms from the end was used to aid in fracture shaft reduction.

7) The guide wire was replacedwith smooth guide wire and reaming done in the distal fragment.



Using cannulated reamer to open the medullary canal

8) Nail insertion: The proximal femoral canal was enlarged to 1mm larger than the distal femoral canal. Reconstruction nail,1mm smaller than the distal reaming was inserted along the guide wire into the distal femur.

9) The lower limb was then abducted 15^0 The neck shaft angle was checked by image intensifier. Femoral proximal targeting guide was fitted.

10) Proper anteversion for the locking screws was ensured: A Steinmann pin was fixed percutaneously along the anterior aspect of the trochanter, parallel to the neck, and checked in C-arm. During insertion, the femoral proximal guide was ensured to remain parallel to this pin to ensure proper

anteversion of the locking screws.

11) In case of excessive resistance during nail insertion-over reaming the canal or choosing smaller size nail was resorted.

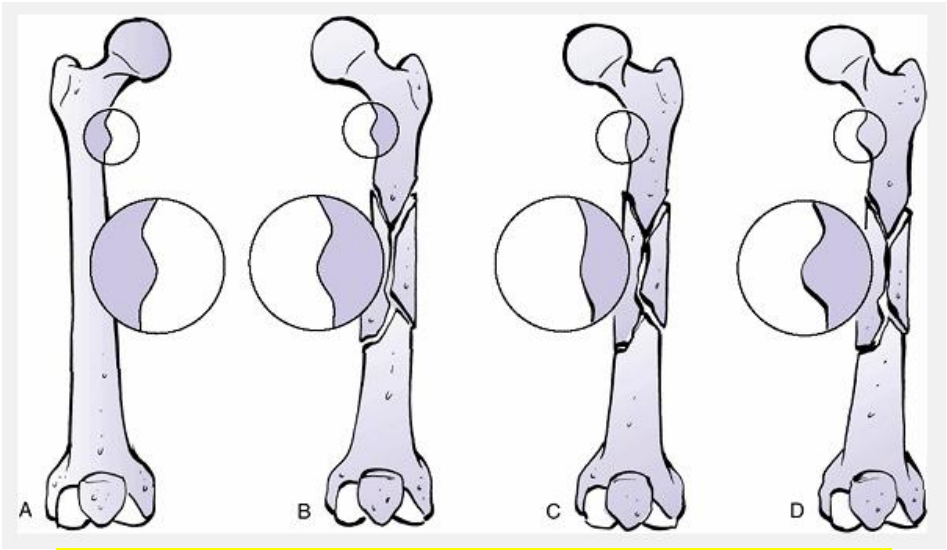
12) Two Proximal locking and two distal locking screws were inserted. Excessive twisting or torquing of the femoral guide was avoided to ensure proper targeting. 5.5mm recon screws were used for proximal locking.

13) Distal locking was done by free hand technique.

14) Position of both screws was checked with c-arm in AP and lateral planes.

15) Nail extraction if required was done using threaded extractor and slap hammer.

INTRAOPERATIVE DETERMINATION OF FEMORAL ROTATION BY SHAPE OF THE LESSER TROCHANTER



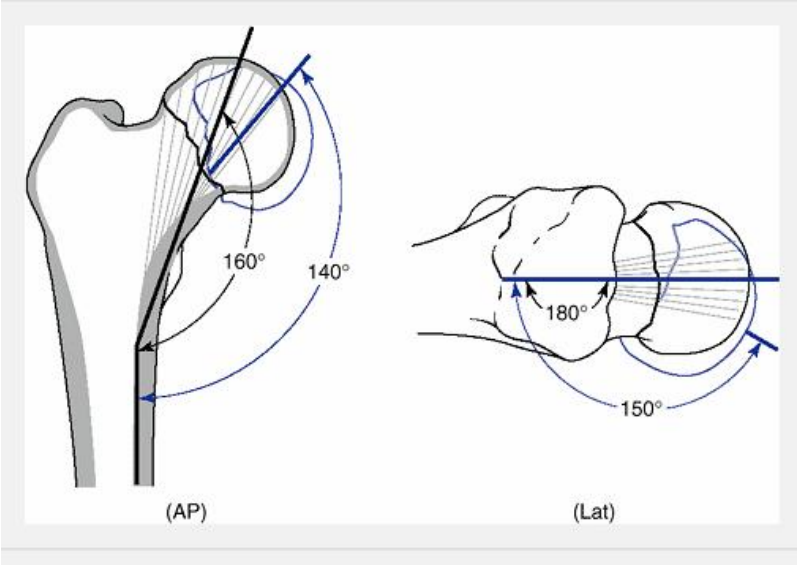
Anteroposterior (AP) fluoroscopic image of the uninjured proximal femur with femur in neutral rotation is stored (A).

The rotation of the proximal segment is adjusted before interlocking, so that the contour and shape of the lesser trochanter are identical. (B).

The lesser trochanter will appear smaller,if the proximal segment is internally rotated(C).

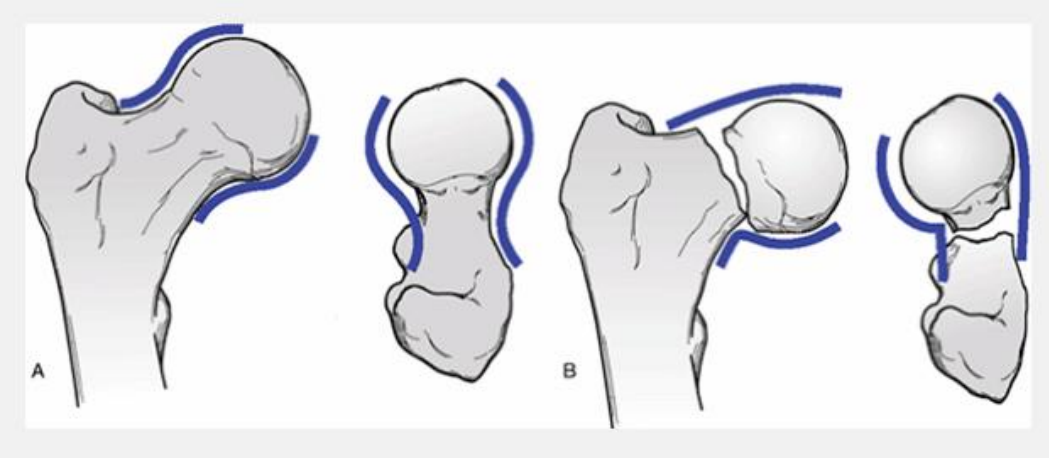
The lesser trochanter will appear larger, if the proximal segment is externally rotated (D).

GARDENS ALIGNMENT INDEX



Angle of 160 to 180 degrees on both AP and lateral views was considered acceptable by Garden. Anatomic (black) and unacceptable (blue) reductions are shown.

LOWELL INDEX



The cortices of an anatomically aligned femoral head and neck. On both x-ray views, they will project shallow S- or reverse S-shaped curves (A).

Malalignment: Flattening of one curve and sharp apex on opposite side (B).

Findings are easier to appreciate by fluoroscopy intraoperatively, than the alignment index, measured by primary compressive trabeculae.

POST OPERATIVE PROTOCOL

- All patients were given pre operative antibiotics and post operatively for 5 days.
- Drain removal was done on 2nd post operative day.
- Suture removal was done on post operative day 12 to 14.
- Patients were advised Non weight-bearing activities for 6 weeks.
- Graduated partial weight-bearing activities were advised for another 6 weeks.
- Radiological and functional examination was done on monthly review for first 6 months and third monthly there

after.

ANALYSIS

Patients general ambulatory status, range of motion and functional status were analysed by using the Freidman and Weiman assessment system[36] at each follow up.

Functional Outcome-Freidman and Weiman System[36]

Result	***Activities of daily living***	***Pain***	***Range of motion***
Good	No limitation	Nil	<20% loss of hip or knee motion
Fair	Mild limitation	Mild to moderate	20-50% loss of hip or knee motion
Poor	Moderate limitation	Severe	>50% loss of hip or knee motion

Post operative Radiological assessment:

Union: 80% of fracture gap is filled with bone trabeculae

Angular malalignment :> 5 degrees of angulation in either the coronal (varus-valgus) or sagittal (flexion-extension) planes.

Rotational malalignment: >15 degrees

Delayed union and non union were contemplated, if the fracture showed no signs of union by 3months and 6 months.

RESULTS

Twenty patients with ipsilateral combined fractures of the femoral neck/intertrochanteric and femoral shaft were treated surgically with reconstruction nail and analysed with average follow up of 13 months ranging from 6 months to 2 ½ years.

The following observations were made.

1) 17 patients (85%) belonged to 3rd and 4th decade. 10 patients (50%) were in the 3rd decade and 7 (35%) patients in the 4th decade.

2) All the patients in our study were males.

3) Fall from height formed the major form of injury in 80% of patients.

4) There were no cases in which the neck fracture was missed at initial diagnosis.

5) Of the proximal femoral fractures 2 were undisplaced basicervical, remaining 18 were displaced fractures; there were 3 basicervical displaced fractures, 14 transcervical displaced fractures, and 1 intertrochanteric fracture.

6) Eight patients had associated other skeletal injuries. One patient had head injury and orbital fracture; and

one patient had rib fracture and haemothorax.

7) In contrast to pelvic injuries, all patients were hemodynamically stable at the time of admission.

8) In our study the average surgical time delay was 18 days ranging from 7 to 49 days.

9) The average surgical time was 3 hours ranging from 2hours 30 mins to 4 hours. The average blood loss could not be estimated in all cases.

10) Three patients have encountered intra-operative complications. In 2 patients there was shattering of the proximal femur during nail insertion. Both of these 2 patients showed good fracture union at the proximally shattered site. However one patient developed infected non union at the shaft fracture site for which second surgery in the form of implant exit and exchange nailing was done.

11) 1 patient had fracture distraction at the site of shaft fracture. This showed good union on follow up.

12) One patient had superficial infection which settled with antibiotics.

13) The average followup period was for 11 months (range 6 months - 2years)

14) Two patients had chronic discharging sinuses from multiple sites on more than 1 year follow-up. The

fractures had however united well. Implant exit and sinus tract excision was done. There was no refracture after implant exit.

15) One patient had infected non-union on 6 months follow-up. He was treated with wound wash and antibiotics; Dynamisation was done later; still there was no union. Second surgery was done outside, when the implant was exited, exchange nailing and bone grafting from iliac crest was done. This patient died during the post-operative period.

16) Except for one patient with non union,there was no varus or valgus malunion of neck or shaft fractures.

17) Limb shortening of 1cms was seen in 3 patients.

18) Improper placing of cervical screws was seen in 3 patients. Two of them were in superior aspect of head and one was of inadequate length.

19) None of the patients had deep vein thrombosis or pulmonary embolism; no thromboprophylaxis was given

20) Delayed union was seen in 2 patients with shaft fracture. Both of them showed signs of union within six months from date of injury, without any further intervention.

21) The average union time was 14 weeks (range,6-28 weeks) for neck fractures and 28weeks (range 25-38 weeks) for shaft fractures.

22) Patient factors such as age, fracture pattern were analyzed to identify their relationship with shaft delayed union. No significant relationship was noted.

23) Twelve patients had full range of motion at hip joint, five patients had 0-110^{o} Range of Motion and three had ROM of 0-100^{o}. None of the patients had fixed flexion deformity at hip.

24) The functional outcome was good in 13 patients, fair in 5 patients and poor in 2 patients.

CASE NO-9: MOHAN, 23,M

Road traffic accident, Basicervical fracture, displaced- neck of femur with distal third shaft of femur fracture, Winquist grade 1. Pt was operated on 12th day. Duration of surgery-4hrs. Implant exit had to be done after 1 year 8 months due to multiple chronic discharging sinuses. Funtional outcome was good. There was no refracture after implant exit.

Pre-Operative

Immediate Post - OP

1 yr 6months post op

Post implant exit

CASE NO-3: SAMINATHAN,34,M

Fall from electric transformer. He was diagnosed to have intertrochanteric fracture and fracture shaft of femur middle thirdWinquist grade 0, surgical time delay of 29 days, operating time 3hrs

Pre operative Radiology

5 months follow up

CASE NO-5: MURUGESAN,45,M

Fall from height, and diagnosed to have segmental fracture shaft of femur with Broad Dynamic Compression Plate in situ and Transcervical displaced fracture neck of femur, surgical time delay of 49 days, Dynamic compression plate implant exit and reconstruction nailing, operating time 2 hrs 3mins.

Pre operative Radiology

50 days post-op

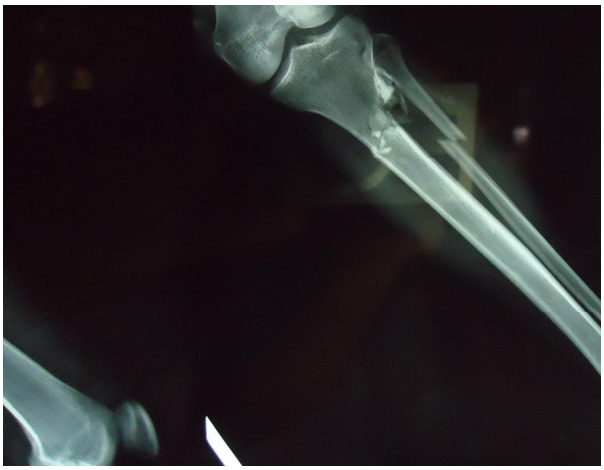
100 days post-op

CASE NO-6, RAMESH,26,M

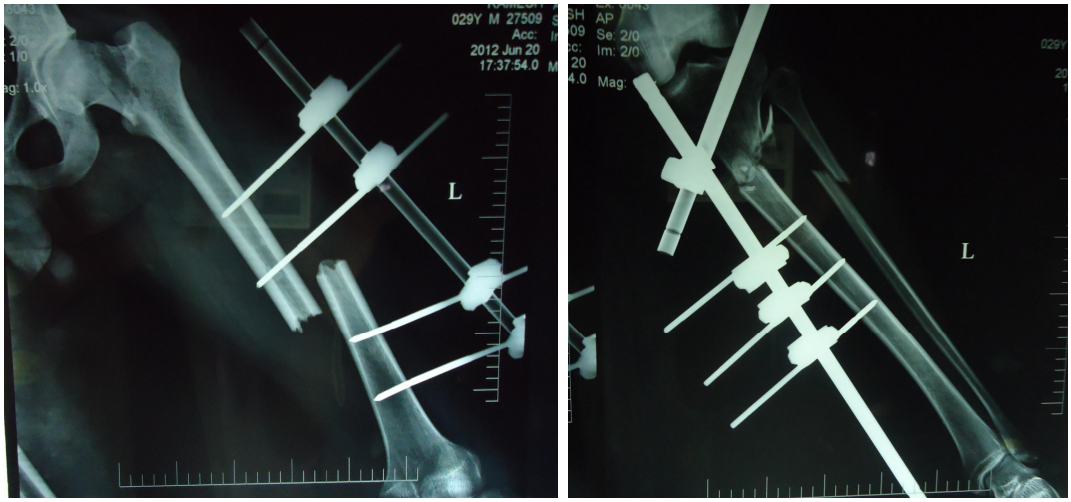
Road traffic accident, He was diagnosed with displaced basicervical fracture neck of femur, middle third shaft of femur, winquist gr 0. Crush injury Contra lateral leg for which Below Knee amputation done, open #both bones Ipsilateral Leg.

Initially knee spanning external fixator was applied. Surgical time delay of 16 days, reconstruction nailing for femur and plating for tibia, operating time 3hrs.

Pre operative radiology



Knee spanning external fixator



Immediate post-op:shattering of prox.femur

5 months post op

DISCUSSION

Our study had 20 patients with combined ipsilateral fractures of the shaft and neck/intertrochanteric fractures. Only 1 patient had intertrochanteric fracture. Other 19 patients had neck fractures.

We have compared our study with other studies reported by Randelli in 1999[38] Hossam et al in 2001[39] Jain et al in 2004[40] Kao et al in 2006[41] and Tsai et al in 2008[42]. These studies have reported only neck fractures in the bifocal femoral combination, but our study included 1 patient with inter trochanteric fracture.

The average follow up period in these studies was around 2 years, but in our study the average follow up was only for 11 months (range 6 months -2years). Only 4 patients had a follow up of more than 1 year 6 months in our study.

The neck fracture union rate in our study was 100%. Similarly Randelli[38] and Hossam[39] reported 100% neck fracture union rates. Other studies by Jain[40], Kao[41]and Tsai[42] have also reported neck fracture union rates fracture union rates above 91%.

The shaft fracture union rate was 95% in our study. Randelli

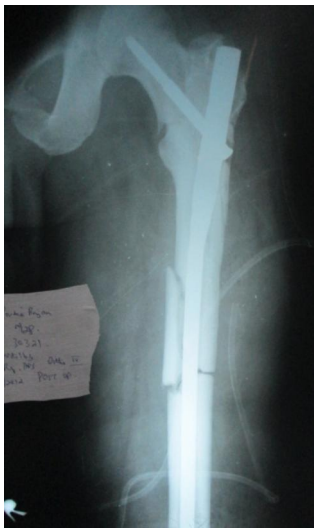
and Hosam have reported 100% shaft fracture union rates. Kao had reported 31% shaft fracture non union among 13 patients in 2006. All the shaft fracture non unions were reported in Winquist 2 and 3 grades of comminution. All patients in our study were in Grade 0 and 1 grades of Winquist comminution.

Factors favouring healing in combined ipsilateral fractures of the femoral neck and shaft are minimal gap, adequate stability and sufficient vascularity[42]. Combined fractures are typically caused by high energy injuries. Moreover, most of the energy is dissipated in the femoral shaft .Consequently comminuted fractures in Winquist grades 3 and 4 have severe soft tissue injury. This was why shaft nonunion are common in Winquist grades 2,3 and 4[42].

The one patient with shaft fracture non-union in our study was due to infection; the operating time in that case was more than 4 hours; that patient had proximal femoral shattering during reconstruction nail insertion. The iatrogenic proximal femoral fracture was extending up to the shaft fracture site.

Pre operative photograph

Immediate post operative X ray showing iatrogenic proximal femoral shattering during nail insertion



The proximal femoral shattering was most probably caused by wrong entry point during nail insertion. Ebraheim[37] had reported in 1998, five cases of proximal femoral shattering during insertion of the reconstruction nail.

2 months post operative

The average neck union time was 3.5 months in our study, comparable to the reported 2.5 months to 4.2 months in other reported studies[38,39,40,41,42]

The average shaft union time was 7 months in our study. Randelli reported a shaft union time of 4.8 months and Tsai reported a shaft union time of 8.8 months.

There were no cases of Varus neck in our study. All other studies have also reported 0% varus malunion. The follow up in our study was only for an average period of 11 months and there were no cases of osteonecrosis on x ray. Randelli and Jain have showed 4% osteonecrosis on MRI studies with a follow up of more than 2 years. Due to dissipation of most of the energy in the femoral shaft in these combined fractures, the avascular necrosis of the femoral head reported in combined fractures is very much less than in isolated neck fractures[42].

Comparison of clinical outcomes with Reconstruction Intramedullary Nails to treat Ipsilateral Femoral Neck and Shaft Fracture

Authors	Case Number	Union Rate (%)		Union time (months)		Varus neck (5)	Osteonecrosis (%)	Infection (%)	Followup (years)
		Neck	Shaft	Neck	Shaft				
Randelli (1999)	27	100	100	3.7	4.8	4	4	0	2.0
Hossam (2001)	9	100	100	4.2	6.9	0	0	11	2.1
Jain (2004)	23	96	83	4	5.5	0	4	0	2.5
Kao (2006)	13	95	69	3	8.5	0	0	0	1.8
Tsai (2008)	32	91	78	4.0	8.8	0	0	0	1.9
Our Study (2012)	**20**	**100**	**95**	**3.5**	**7**	**0**	**0**	**15%**	**11 mths**

There were no cut out of proximal locked screws in our study. Tsai had reported one isolated neck non union which was complicated by cut-out of the proximal locked screws at 5 months. Similarly one isolated shaft nonunion reported in Tsai was associated with distal locked screw breakage at 7 months.

Tsai reported a patient with combined non union of both the neck and shaft; this was treated with bipolar hemiarthroplasty for the neck nonunion and dynamic compression plating with bone grafting for the shaft nonunion.

This study has several limitations. We had only small number of patients with limited statistical significance, thereby we could not make any meaningful analysis among the even smaller sub-groups.

The follow up period was very short. Long term complications like avascular necrosis of head of femur and degerative changes require a longer follow up. Investigations like CT scan were not done in all patients due to patients not being able to afford them. Magnetic Resonance Imaging studies are needed for picking up early avascular necrosis changes and MRI studies were not done

during follow up in our study.

There was an average surgical time delay of 18 days (range 7 days -49 days); all available studies[5-15,36-42] recommend early fixation to avoid longterm complications of avascular necrosis. Hence long term follow up of these cases is required to report on long term complications due to surgical delays of more than 20 days. There are no available studies in the literature where long term complications have been analysed in reconstruction nail for bifocal femoral patients with surgical delays of more than 20 days.

Garg[24] showed that fractures that were reduced anatomically and fixed internally healed even when treatment was delayed. This suggests that stable anatomic reduction and not the early surgical intervention is vital for neck union in these combined fractures. Also the rate of neck non-union in these combined fractures is much less than in isolated neck fractures because much of the energy is dissipated in the shaft.

The average duration of surgery was also longer than in other studies; this could be because of the steep learning curve associated with this procedure. In both the cases of implant exit done due to chronic discharging sinuses, and in the case of infected non union at the

shaft, the duration of surgery was more than 4 hrs.

In all cases we had to resort to open reduction to achieve anatomical reduction, because of difficulties encountered in achieving closed reduction; this is against the closed nailing advantage conferred by reconstruction nail implant. The operating time reported in other studies was for closed reconstruction nailing.

The mean age of patients in our study was 28 years which is lower than other studies. This could also have contributed to the good results. There were only male patients. Fall from height was the predominant mechanism of injury whereas it was road traffic accident in other studies.

Because of not taking CT scan in all cases some cases of undisplaced femoral neck fractures could have been missed altogether. Factors influencing the functional outcome could not be determined because of small numbers in the sub group analysis.

There were no cases of implant failure. Multiple cervical screws provide rotational and vertical stability. There were no cases of posterior placement of screws in the neck. This could be because of the inbuilt 70 degrees of antiversion angle.

Anatomical reduction of fracture neck of femur, precise entry point and cervical screws placement precisely in the neck were found to be most demanding and challenging surgical steps. Difficult reduction was encountered inGarden grade III fractures of neck of femur with comminution.

The two cases of proximal femoral shattering could be because of wrong entry point.

The very high percentage of good and fair functional outcomes could be attributed to the fact that all femoral shaft fractures were in Winquist grades 0 and 1 communition. Femoral shaft fractures with Winquist grade 3and 4 communition lead to poor functional outcomes[42]. The comminuted fractures are prone to non-union because of tearing of blood vessels. Recent studies[25,26] have also shown 100% union rate inspite of initial displacement. It is easier to maintain reduction in minimally displaced fractures. But achieving reduction in displaced and comminuted fractures is challenging even for the most experienced hands[26,42].

A longer follow up with more number of patients, is needed to comment on long term complications.

CONCLUSION

In our short term study of 20 patients, we were able to obtained satisfactory results with minimum complication rate. With improvement in surgical experience, we can be able to reduce the operating time and the need for opening up the fractures, in order to achieve reduction which will further produce better results.

We had several set-backs in our patients, namely delayed the time interval before surgery, open reduction in order to achieve alignment in all cases, and more number of patients with displaced neck fractures. But inspite of these set-backs, we were able to achieve excellent results in terms of neck union and shaft union and no cases of malunion. We had one overwhelming advantage in that all our shaft fractures were belonging to winquist grades 0 and 1 in comminution.

Hence, we conclude that reconstruction nail is a good option for Winquist 0 and 1 grades of comminution at the femoral shaft fracture, but the functional outcome could be different in patients with marked displacement and higher grades of comminution at shaft fracture site. The results could be improved with further

experience and learning and needs further evaluation. Surgeon's experience in managing these complex injuries cannot be over emphasized.

Long term follow up of these patients is required to report on long term complications like avascular necrosis which may result due to the delayed surgical time interval.

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S. No	Name & IP No	Age years	Sex	Date of injury	Mode Of injury	#NOF	#SOF WinGr	Asso. Injuries	Date Of surgery	Time Delay In days	Procedure	Surgical time	Complications	Follow Up	Result
1	Vinayagmort 69031	20	M	19.1.11	RTA	TC,Dis	M/3 1	Nil	31.1.2011	12	Recon nail	4 hours	INFECTION Implant exit	2years	Good
2	Mohan 67402	23	M	27.11.10	RTA	BC,Dis	D/3 1	Nil	11.12.10	15	Recon nail	4 hours	INFECTION Implant exit	2 year	Good
3	Saminathan 44084	34	M	13.5.12	Fall height	IT#,dis	D/3 0	Nil	11.6.12	29	Recon nail	3 hours	Nil	7months	good
4	Pandirajan 35012	28	M	12.4.12	Fall height	TC,Dis	M/3 0	#SPR, #IPR	29.4.12	17	Recon nail	4 Hours	Shattrng prox femr Infected NU of shaft Dynamisatn Impl.Exit&BG died	8months	poor
5	Murugsan 45389	45	M	16.5.12	Fall height	TC,Dis	Segmntal With BDCP in situ	nil	4.7.12	49	Recon nail	2hours 30min	Nil	6mon	good
6	Ramesh 55384	26	M	3.6.12	RTA	BC,Dis	M/3 0	Crush inj-C/L leg #BB I/Lleg	9.7.12	16	B/K amputn C/L leg Ext.fixator Recon nail Plating tibia	3 hours	Shatterng of prox femr	6months	poor
7	Kubendran 62878	30	M	6.7.12	Fall height	BC,Undisp	SegmntlM/3 0	Head inj # patella	19.7.12	13	TBW patella Recon nail	3 hours 30 mins	Nil	6 mon	fair
8	Ramachandrn 57521	37	M	20.3.12	Fall heigh	TC,Dis	M/3 0		27.5.11	7	Recon nail	2 hrs 30 mins	Nil	6 mon	fair
9	Mohan 46807	23	M	29.5.11	Fall heigh	TC,Dis	M/3 0	Rib # hemothorax	6.7.11	38	Recon nail	3 hrs	SOF# distraction	1 ½ years	good
10	Kamalkannan	35	M	30.5.11	RTA	TC,Dis	M/3	#BB Leg Rt	6.6.11	7	Recon nail	3 hrs	Nil	1 ½ years	Fair

S. No	Name & IP No	Age years	Sex	Date of injury	Mode Of injury	#NOF	#SOF WinGr	Asso. Injuries	Date Of surgery	Time Delay In days	Procedure	Surgical time	Complications	Follow Up	Result
	80570						0								
11	Mayilsamy 76365	40	M	26.8.11	Fall heigh	TC,Dis	M/3 1	Distal radius #	3.9.11	8	Recon nail	3 hrs	Nil	10 mon	good
12	Velmurugan 80657	35	M	4.9.11	Fall heigh	TC,Dis	M/3 1	Nil	12.9.11	8	Recon nail	180 min	Nil	1 year	fair
13	Ramkumar 78906	30	M	22.9.11	RTA	TC,Dis	M/3 0	B/L SPR, IPR. # Lt clavicle	9.9.11	17	Recon nail	180 min	Nil	1 year	Good
14	Senthil 92880	29	M	14.10.11	Fall height	TC,Dis	M/3 1	Nil	29.10.11	15	Recon nail	2hrs 30 mins	Nil	1 year	good
15	Muthukumar 107275	29	M	29.11.11	Fall height	TC,Dis	M/3 1	4th MC # Rt	18.12.11	19	Recon nail	3 hrs	Nil	9 mon	good
16	Kannan 109870	29	M	8.12.11	Fall height	TC,Dis	M/3 0	Nil	23.12.11	15	Recon nail	180 min	Nil	10 mon	good
17	Thangadurai 117652	38	M	19.12.11	Fall height	BC,Undisp	M/3 1	Nil	5.1.12	16	Recon nail	3 hrs	Nil	10mon	good
18	Aruljothi 97981	29	M	31.1.12	Fall height	BC,disp	M/3 3	Nil	16.2.12	16	Recon nail	2hrs30 mins	Shortening 1ss cms	8 mon	poor
19	Natesan 62461	28	M	17.3.12	RTA	TC,Dis	M/3 1	Nil	2.4.12	15	Recon nail	3 hrs	Nil	8 mon	fair
20	Karthik 77584	18	M	20.8.11	Fall height	TC,Dis	M/3 1	Nil	11.9.11	21	Recon nail	150 min	Nil	1 year	good